TITLE
ASP Conference Series, Vol. **VOLUME**, **PUBLICATION YEAR**
EDITORS

System to estimate ages and redshifts for radio galaxies

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Abstract. The system allowing a user to operate at server with simulated curves of spectral energy distributions (SED) and to estimate ages and redshifts by photometric data **sed.sao.ru** is described.

Appearing of huge volume of observational data in the optical and infrared wavelength range increases significantly our knowledge about the far Universe. However, information about space distribution of extragalactic objects is not yet accessible because of the limits of observational possibilities: the direct measuring of redshifts is possible with spectroscopic methods having a sensitivity 2 magnitude lower than photometric ones. The special interest lays in the study of distant objects allowing astronomers to investigate both Universe structures and evolution of active galactic nuclei (AGNs) (which are connecting with black holes). Spectroscopy of such objects is rather difficult. However, using photometric data one can essentially simplify this problem since it allows an astronomer to make the initial selection.

To accelerate a procedure of age (and photometric redshift) estimation we have begun a project "Evolution of radio galaxies", which has to allow a user to obtain age and photometric redshift estimations. The main tasks of the system are: 1) estimation of ages when fixed redshift z; 2) estimation of both ages and z; 3) archiving of optical observations of RC radio galaxies (in FITS, JPEG, PS formats with text comments); 5) archiving of the main publications by the current topic; 6) developing of the HTPP and e-mail access; 7) local SED operation to simulate an observational process.

To estimate ages and redshifts by photometry data we operate with simulated curves of spectral energy distributions (SED) for different types of galaxies of two models PEGASE (Fioc, Rocca-Volmerange, 1997, 1999), GISSEL96 (Bruzual, Charlot, 1993; Bolzonella et al., 2000).

Before the estimation of values we smooth a SED with a filter transmission curve to simulate observational data using a "compressing" filter with the growth of redshift: $S_{ik} = \frac{\sum_{j=0}^{n} s_{i-n/2+j} f_{jk}(z)}{\sum_{j=0} f_{jk}(z)}$. Here s_i is the initial synthetic SED, S_{ik} is the smoothed SED by the k-th filter, $f_k(z)$ is the transmission in the k-th filter, "compressed" in (1+z) times when "moving" along the SED, j=1,n is the pixel index in a curve of filter transmission.

The estimation of ages and redshifts is performed by way of selection of the optimum location on the SED curves of the measured photometric points obtained when observing radio galaxies in different filters. We use the already computed table SED curves for different ages. Using discrepancies we construct a probability function in the form of $p = \frac{1}{max} exp(\chi^2)$, where max is the maximum value of the calculated function. χ is the discrepancy calculated by the slipping of the photometry points along the SED curve:

$$\chi^{2} = \sum_{k=1}^{Nfilters} \left(\frac{F_{obs,k} - pSED_{k}(z)}{\sigma_{k}} \right)$$

Here $F_{obs,k}$ is the observational magnitude in the k-th filter, $SED_k(z)$ is the simulated magnitude for the given SED in the k-the filter at the given redshift z, p is the free coefficient, σ_k is the error of the observed magnitude.

In order to take account of the absorption, we apply the maps (as FITS-files from the paper "Maps of Dust IR Emission for Use in Estimation of Reddening and CMBR Foregrounds" (Schlegel et al., 1998).

The system is situated on the special Web-server http://sed.sao.ru operating in the Linux Red Hat (6.2) system, unifying various type resources and accessed by FTP, HTTP and e-mail. Typical e-mail form of request looks like this:

```
seds start
object 3C65; model PEGASE, type=E
z_limits: 0 6, age_limits: 200 16000
B=23.73+0.21 V=23.57+0.2 R=22.36 I=20.81
extinction off
seds end
```

Here seds start and seds end are opening and closing keywods of the form. Keywords object, model and type determine an object name, a type of a model and a type of a galaxy, respectively. Available galaxy types are E, S0, Sa, Sb, Sc, Sd. z_limits and age_limits determine the limits of search for a redshift and an age (in Myr). The observed magnitudes age given with B, V, R, I, J, H, K, g, r, i, etc. keywods corresponding to the filter names. The error of the magnitude detection is given via plus '+' after a value of the magnitude. Extinction in this example is not calculated.

Another supported possibilities are a)sorted bibliographical collection of papers for different stages of radio galaxy evolution; b) archive of radio galaxies data in various wavelength ranges (both observed in Special astrophysical observatory and taken from Internet), containing information on the objects and figures in FITS, JPEG and PostScript formats.

The project was supported by the Russian Foundation of Basic Researches (grant No 99-07-90334).

References

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